

WHAT IS CLAIMED IS:

1. A method of processing a semiconductor wafer that reduces plasma-
induced damage to the wafer comprising performing the following while maintaining a
5 plasma in a reaction chamber:

inserting the wafer into the reaction chamber;

performing a plasma process on the wafer at a process temperature;

cooling the wafer to a removal temperature which is less than the process
temperature; and

10 removing the wafer from the reaction chamber.

2. The method of Claim 1, wherein the removal temperature is at least
between about 100°C and about 500°C below the process temperature.

15 3. The method of Claim 1, wherein the process temperature is greater than
about 300°C and the removal temperature is less than about 300°C.

4. The method of Claim 1, wherein the removal temperature is between about
80°C and about 300°C.

20 5. The method of Claim 1, further comprising cooling the wafer to between
about 15°C and 30°C before inserting the wafer into the reaction chamber.

6. The method of Claim 1, wherein the plasma process is plasma deposition of silicon dioxide.

7. The method of Claim 6, wherein the process temperature is between about
5 275°C and 325°C.

8. The method of Claim 1, wherein the plasma process is plasma deposition of fluorine doped silicon dioxide.

9. The method of Claim 8, wherein the process temperature is between about
10 325°C and about 375°C.

10. The method of Claim 1, wherein the plasma process is plasma deposition of silicon dioxide for shallow trench isolation.

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11. The method of Claim 10, wherein the process temperature is between about 400°C and about 550°C.

12. The method of Claim 1, wherein the plasma process is plasma deposition
20 of phosphorous-doped silicon dioxide.

13. The method of Claim 12, wherein the process temperature is between about 400°C and about 550°C.

14. The method of Claim 1, wherein the plasma process is plasma etch of photoresist.

5 15. The method of Claim 1, wherein cooling the wafer to a removal temperature is cooling the wafer for between about 2 seconds and about 30 seconds.

16. The method of Claim 1, wherein cooling the wafer to a removal temperature comprises blowing a gas over the wafer.

10 17. The method of Claim 1, wherein an idle plasma condition is used while inserting the wafer, cooling the wafer, and removing the wafer.

15 18. The method of Claim 1, wherein the wafer comprises a gate dielectric layer.

19. A method of processing a semiconductor wafer that reduces plasma-induced damage to the wafer comprising:

cooling the wafer to a temperature below about 100°C;

20 transferring the wafer into a reaction chamber;

igniting a plasma within the reaction chamber;

performing a plasma process on the wafer at a process temperature;

cooling the wafer to a removal temperature which is less than the process temperature while maintaining the plasma; and

removing the wafer from the reaction chamber.

- 5 20. The method of Claim 19 wherein the plasma is extinguished while removing the wafer from the reaction chamber.